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Comparative Evaluation of the Treatment of Transcondylar Fractures of the Humerus in Children

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Abstract:

Now days there are presented the reasons for the relevance of transcondylar fractures in children with the solution of their problems by various methods of osteosynthesis. The results of surgical treatment are evaluated with subsequent comparison and selection of a more effective technique. The study material includes 522 patients, which 377 were operated on using the Ilizarov apparatus after closed reposition. The conclusion is based on 94.3% positive results with the proposal of our technique as the choice of osteosynthesis for transcondylar fractures.

Introduction

Transcondylar fractures are most common among fractures of the dystal end of the humerus in children; according to some authors, they range from 40.3% to 66.4% of all fractures in this area. Almost 80% of them require reposition or surgery, since improper union of the transcondylar fracture can lead to various types of contractures and deformities in the elbow joint in the future. Analysis of scientific and clinical documentation shows that the age group of patients ranges from 2 to 15 years. Considering the choice of treatment tactics, at first there is the question of the mechanism of injury. A survey of patients or parents shows that when falling on the maximally extended elbow joint, the distal fragment is displaced posteriorly and this leads to an extensor transcondylar fracture. If the impact force falls on a bent joint, then we are talking about a flexion type. The rotational component is also quite important, so if at the time of the injury the forearm was pronated and the shoulder was in the position of internal rotation, then the muscles that rotated the humerus outward were tense, then the proximal fragment rotated outward. When falling on the hand with a supinated forearm and externally rotated shoulder, the direction of rotational displacement will be completely different: the peripheral fragment remains in the position of external rotation, and the central fragment, freed from connection with the peripheral one after the fracture due to the contraction of the internal rotators of the shoulder, rotates inward. As practice and data from scientific publications show that it is a competent understanding of the biomechanics of injury in transcondylar fractures that allows us to resolve the issue of treatment in favor of a favorable outcome. Given that this type of fracture is intra-articular, the problem of impaired blood supply and trauma to the nerves of the upper limb is undoubtedly affected. Many authors divide complications into early and late complications, so early complications can include circulatory disorders and Volkmann's ischemic contracture. Circulatory disorders can occur as a result of compression of the brachial artery and its arterioles by post-traumatic edema, hematoma, or bone fragments. A complete rupture of the artery is rarely observed, but a formidable complication as a result of prolonged compression and a violation of the venous outflow is Volkmann's contracture. Naturally, first hours after an injury, pathomorphological changes play a huge role in the development of the latter, manifested by the appearance of edema and impaired hemodynamics, as well as monitoring the growth of the edematous process after reposition and the application of a

plaster cast. It should be noted that only errors in the management of the patient by a doctor and the irresponsible attitude of parents can lead to Volkmann's contracture in transcondylar fractures. Also, an early complication in the acute period is post-traumatic nerve paresis. It is known that in the projection of the condyles of the humerus there are 3 large nerves: the ulnar, median and radial. In the development of the pathogenesis of nerve damage, compression and ischemia play, which occur as a result of nerve tension by a fragment, infringement between fragments, compression by surrounding tissues or its rupture. As some authors point out a sharp change in partial pressure during an injury in the fascial sheaths, where the nerve trunks are localized, is particular importan. Improper management of the patient, due to a diagnostic error, in the acute period leads to persistent neurological changes, even after satisfactory union of the fracture. There are few cases in the literature when neurolysis was performed in patients with compression-ischemic nerve paresis, so the treatment of neurological changes in transcondylar fractures is usually conservative. Over the past decade, a large number of works have been devoted to the surgical treatment of transcondylar fractures. Many questions remain unresolved, including the choice of osteosynthesis method, the need for open or closed reduction, and the timing of fixation. The main discussion is around the method of fixing bone fragments, as some researchers point to a closed reposition followed by osteosynthesis with cross-pins and immobilization with a plaster bandage. Considering this technique, where the results indicate a good result in terms of union, but the elimination and retention of the rotational component is not sustainable. In many scientific publications, a long-existing method of surgical treatment is noted, by open reposition of bone fragments with fixation with pins. When discussing various surgical interventions for transcondylar fractures using pin osteosynthesis, many agree that there is a problem in terms of stable fixation, pin migration, and the lack of complete elimination of rotation on postoperative radiographs. Some authors describe combined osteosynthesis with the use of rod devices, which provide stable fixation and compression, and for the rotational component, the pin is inserted diagonally in the frontal plane. When studying the problem, an alternative method of surgical treatment of transcondylar fractures can be considered the use of elastic osteosynthesis, by antegrade placement of rods. The choice of the latter, the researchers determine the absence of iatrogenic lesions of the ulnar nerve, but the results show antecurvation and a deficit of movements in the elbow joint. It follows that the recognition of symptoms, preference for the method of diagnosis and method of treatment of transcondylar fractures are a solved problem, and the choice of osteosynthesis technique is the prerogative of the clinic. Review and analysis of literature data requires comparison of the results with subsequent differentiation of various methods of surgical treatment of transcondylar fractures of the humerus in children.

Purpose of the study was a comparative assessment of the effectiveness of the treatment of transcondylar fractures of the humerus in children.

Materials and methods

The study includes 522 patients treated in the Department of Pediatric Traumatology of the State Institution RSSPMCTO for the period from 2015-2019. with transcondylar fractures. By gender, the patients were distributed as follows: 319 (61.1%) boys and 203 (38.9%) girls. In terms of age, the youngest patient who was operated on at the age of 1.5 years, and the oldest 15 years. The average age was 7 years. On the side of the lesion, right-sided injuries predominate - 346, and left-sided, respectively, 176 cases. The prevailing part of patients, i.e. 513 clinical cases were hospitalized through the emergency department for a period of 1 to 3 days, 9 patients applied for 10-14 days after injury. Among all children, a survey was conducted on the visual analogue scale (VAS) of pain intensity, where 60% had moderate pain (45–74 mm), 32% had severe pain (75–100 mm), and the rest had mild pain (5–74 mm). 44 mm). All patients after the subsidence of edema

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underwent standard two-projection radiography in frontal and lateral projections. On the basis of control, in addition to lateral displacement, 416 (79.6%) patients had an extensor type of transcondylar fracture, anterior displacement of the dystal fragment was in 88 (16.8%), only 18 patients (3.6%) were presented with only a rotational component . A characteristic radiological sign of fractures with rotational displacement was a different width of the shadow of the dystal and proximal fragments in the profile projection. In 12 cases, an MSCT study was performed with 3D modeling, which made it possible to determine the direction of rotation. In addition to the pain syndrome, in 8% of cases there was an acute or gradual violation of the blood supply to the upper limb. To assess the degree of perfusion and hemodynamic disturbances, visual, temperature studies of changes in the fingers were carried out, and for the presence of a pulse, they resorted to using pulse oximetry. A good degree of perfusion was characterized by warm, pink fingers, rapid filling of the nail bed after pressure, and normal saturation readings on oximetry. Cold, pale fingers, slow or no filling of the nail bed with low saturation values refers to a poor degree of perfusion. Only 2 patients underwent immediate relaxation of the plaster cast during treatment due to the onset of Volkmann's contracture. As mentioned above, often transcondylar fractures are accompanied by post-traumatic nerve paresis, so in 56 patients there was damage to the ulnar nerve, in 23 the median nerve, paresis of the radial nerve was noted in 6 cases. Combined damage to the nerves of the elbow joint was observed in 4 patients. All patients underwent an ENMG study and consultation with a neurologist prior to the operative period. In addition to drug treatment, a splint was applied to the patient in the extensor position of the hand in order to relax the surrounding soft tissues to improve nerve trophism. For the distribution of patients, the Gartland classification of Trans- and supracondylar fractures was used, where type I was 33 (6.3%) patients, accompanied by minimal displacement. Type II included 112 (21.4%) patients, characterized by a slight displacement and received conservative treatment, by repeated closed reposition and the imposition of a plaster cast. Surgical intervention was performed in 321 (61.4%) patients with complete displacement in all planes and rotation of bone fragments, which belong to type III fractures according to Hartland. Also, 56 (10.9%) patients who, in addition to complete displacement, had neurovascular complications were also classified as type IV. They were operated on due to the high risk of malunion. During surgical intervention, for the purpose of stable fixation, the Ilizarov apparatus was used with a set of 0.5-0.5 half rings, which made it possible to adjust bone fragments in the intra- and post-operative period.

Results and discussions

When studying the literature, many authors point to the serious need for stable fixation with the elimination of displacements in all planes, which is the most important aspect of preventing further deformities and contractures. Many authors believe that the classic method of osteosynthesis for transcondylar fractures is cross-fixation with Kirschner wires. Rajeev Kumar, who has used closed and open reduction with cross-fixation, publishes data showing that 46 patients had satisfactory Flynn scores, and 4 were unsatisfactory. At the same time, after open reposition, 3 patients had iatrogenic lesions of the ulnar nerve, 4 had migrating pins, and 5 had nonunion after osteosynthesis. Gerasimenko M.A. reports that in closed reposition with transosseous osteosynthesis with pins in 132 patients, only 1.2% had transient post-traumatic neuropathies of the radial and median nerves. M. Abadneh et al. when using closed reposition with the classical method of fixation, 76% of patients had a good result, but 2 developed post-traumatic varus deformity, and 1 valgus. With open reposition, 55% have a good result, 5% have a decrease in the deficit of movements, and 7% have cubitus varus. Raising the issue of surgical access for open reposition, Proshchenko Ya.N. due to the modification of the incision in the main group in 32 cases, achieved positive results due to relatively low trauma in relation to the triceps muscle, due to the mobilization of the latter along the

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intermuscular spaces. Krishna Kiran Eachempati et al., who obtained good results in 95% according to the Flynn criteria, the Bauman angle was restored in all patients with closed (45) and open (5) reposition. Tarasov V.I. notes that in the treatment of 375 patients with transcondylar fractures, in most cases they received a good result, only in 2 examples after open reposition, flexion-extension contracture 20-300 was observed, and in 11 post-traumatic varus deformity. The author causes contracture by scarring of soft tissues and dissection of the triceps muscle, and the development of cubita vara by residual rotational displacement and aseptic necrosis of the block. Depending on the lateral displacement, many authors have used medial or lateral pinning. So, colleagues from The Tamilnadu DR.M.G.R. MEDICAL University report lateral pinning with 80% good results, 20% decreased range of motion. Particular attention deserves the work of Bazhanova N.N., which describes a differential approach to the treatment of trans- and supracondylar fractures. All methods of pin fixation are described, which amounted to 241 patients after closed reposition with an excellent result from 55 to 95% and 11 cases with open reposition of bone fragments, respectively, with an excellent result from 70-95%. An unsatisfactory result, the author received with combined osteosynthesis with a screw and a pin, due to the presence of pain and restriction of movement after 6 years. Agreeing with the opinions of colleagues, and accepting all existing methods of treating transcondylar fractures of the humerus in children with an assessment of the results, we understand the need to familiarize ourselves with our methodology and treatment results for comparison. The Bromberg-Marrow scoring system was used to assess joint function, where an excellent clinical result (94.3%) included patients who had no movement deficit and any deformities, the presence of adhesion on the control radiograph, complete restoration of trophism with no neurological manifestations. and the return of self-service. In (5.7%), a good result was noted, because there were residual neurological elements, the recovery of which did not depend on the union of the fracture. The effectiveness of surgical treatment of transcondylar fractures was assessed clinically and radiologically for a period of 2 weeks to 6 months. after operation. The use of the Ilizarov apparatus makes it possible to achieve stable fixation with the elimination of displacements in all planes, including the rotation of fragments. After general anesthesia, a closed reposition of the humerus is performed, then 2 Kirschner wires are carried out in the frontal plane: 1 - through the olecranon of the ulna, 2 - through the upper third of the humerus. After installing the Ilizarov apparatus with a set of 0.5-0.5 with moderate distraction in the apparatus, an additional Kirschner wire is inserted in the sagittal plane with a thrust platform through the distal end of the proximal fragment, one end of which is mounted to the lower half-ring of the Ilizarov apparatus using straps and a bracket. Inpatient treatment lasted an average of 10 days, after the operation, the patient underwent control radiography with subsequent correction in the apparatus, if necessary. Repeated radiography was performed at a period of 4-5 weeks, in the presence of adhesion, the metal structure was removed on an outpatient basis, which is an undoubted advantage due to the absence of a second operation.

Conclusion

The use of the developed method of surgical treatment, including osteosynthesis with the Ilizarov apparatus, provides satisfactory results in 94.3% of operated patients.

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